**+Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, DC 20554**

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| In the Matter of | ) | |
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| Use of Spectrum Bands Above 24 GHz For Mobile Radio Services | ) | GN Docket No. 14-177 |
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| Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands | ) | IB Docket No. 15-256 |
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| Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services | ) | WT Docket No. 10-112 |
| | ) | |
| | ) | |
| Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations | ) | IB Docket No. 97-95 |

**REPLY COMMENTS OF FACEBOOK, INC.**

Facebook, Inc. ("Facebook") is pleased to submit these Reply Comments to the Commission's *Second Further Notice* in the above-captioned proceeding.[1] Facebook's mission is to give people the power to build community and bring the world closer together. Connecting people is a critical first step in executing this mission. Today, more than four billion people—

[1] *Use of Spectrum Above 24 GHz for Mobile Radio Services et al*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd. 10988 (2017) ("*Second Further Notice*").

53% of the people on the planet—are still not connected to broadband Internet.[2] Connecting these people—most of whom live in the developing world—is a complicated effort that requires not just bringing network infrastructure to more people, but involves addressing the regulatory environment. To do its part, Facebook, working with a range of partners, has launched several initiatives focused on connecting the unconnected and under-connected.

As the Commission is aware, spectrum policy and regulations affect both the affordability and availability of broadband Internet. Improving connectivity in the United States and around the world means pursuing spectrum policy that maximizes the utilization of this limited resource and promotes the expansion of both the capacity and coverage of wireless networks. To this end, the Commission should continue to allow for flexible use across platforms within the additional spectrum bands it is considering in this *Second Further Notice,* and begin to consider licensing schemes for high-altitude platforms that can be deployed in certain millimeter wave spectrum in support of the 5G ecosystem.

Facebook focuses these Reply Comments on the use of upper microwave spectrum for stratospheric platforms, such as its fixed-wing solar-powered unmanned aerial system (UAS) plane called *Aquila*, designed for affordable broadband backhaul and emergency communications.[3] Facebook co-chaired the working group of the Commission's Technological Advisory Council ("TAC") on Mass Deployment of Aeronautical and Space Transmitters that

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[2] The Economist & Intelligence Unit, *The Inclusive Internet Index: Bridging digital divides* 8 (citing ITU, *Key ICT indicators for developed and developing countries and the world, 2005-2016*) *available at* https://theinclusiveinternet.eiu.com/assets/external/downloads/3i-bridging-digital-divides.pdf.

[3] Aquila completed a full-scale test flight in 2017. *See* Associated Press, *Facebook drone that could bring global internet access completes test flight*, The Guardian, Jul. 2, 2017, available at https://www.theguardian.com/technology/2017/jul/02/facebook-drone-aquila-internet-test-flight-arizona.

focused on new broadband platforms made possible by innovations in a range of technical inputs. The TAC's working group, with broad industry participation, recommended that the Commission gather information on the payload services for large UAS, particularly high-altitude platform stations ("HAPS"), their targeted applications and sharing techniques with incumbent users.[4]

Facebook urges the Commission to implement a regulatory framework to enable persistent stratospheric-based communications and infrastructure, such as HAPS, in bands where they can operate compatibly with other permitted uses to complement ground-based mobile and fixed systems for 5G and satellite systems. Facebook's public support for HAPS and its proposal to the Commission to implement a regulatory framework to enable HAPS in the upper microwave bands considered in this proceeding is also reflected in other companies' filings such as Elefante Group's proposal, which is backed by Lockheed Martin's compatibility and sharing studies.[5]

There is growing global interest in stratospheric platforms for broadband. The Aerospace Industries Association (AIA) has created an Upper-Airspace Working Group that Facebook

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[4] *See* Meeting Presentation of the TAC (December 7, 2016), available at https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting12716/TAC-presentations-12-7-16.pdf at 70.

[5] *See* Comments of Facebook, Inc. at 2-5, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 (filed Sep. 30, 2016) ("In less dense areas, where broadband infrastructure must be deployed over large areas, using high altitude solar-powered unmanned aircraft to provide backhaul-type links to terrestrial aggregation points may be part of the optimal solution.") ("Facebook FNPRM Comments"); *see also* Comments of Elefante Group, Inc. on the *Second Further Notice of Proposed Rulemaking* at 2-3, 7, GN Docket No. 14-177, IB Docket No. 15-256, WT Docket No. 10-112, IB Docket No. 97-97 (filed Jan. 23, 2018) (noting collaboration with Lockheed Martin Corporation).

currently chairs to coordinate industry policies unique to high-altitude platforms.[6] Recent announcements from the mobile industry and aviation manufacturers attest to the growing interest in this promising platform for closing the digital divide and extending affordable broadband into rural markets.[7] Additionally, Facebook believes that HAPS would be well-suited to facilitating critical emergency communications links during natural disasters. HAPS have the potential to be deployed rapidly during and after emergencies yet remain in place for long periods of time. The United Nations Broadband Commission report concluded that HAPS would be a "valuable alternative" in natural disasters, which "can often overload traditional networks, and ground-based infrastructure is itself vulnerable to damage."[8]

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[6] *Upper Airspace Working Group Paves Way for New and Emerging Aerospace Technologies,* Aerospace Industries Association Blog (Jul. 5, 2017), https://www.aia-aerospace.org/upper-airspace-working-group-paves-way-for-new-and-emerging-aerospace-technologies/

[7] Press Release, AeroVironment, AeroVironment Announces Joint Venture and Solar High-Altitude Long-Endurance Unmanned Aircraft System Development Program (Jan. 3, 2018), available at http://www.avinc.com/resources/press-releases/view/solar-high-altitude-long-endurance-uas; Press Release, Thales Alenia Space, Stratobus Project Takes Off! (Apr. 24, 2016), available at https://www.thalesgroup.com/sites/default/files/asset/document/pr_stratobus_kick_off_20160426_en_0.pdf; Press Release, Airbus, Airbus and Williams Advanced Engineering team to explore technology collaboration (Dec. 18, 2017), available at http://www.airbus.com/newsroom/press-releases/en/2017/12/airbus-and-williams.html.

[8] United Nations Broadband Commission for Sustainable Development, *Working Group on Technologies in Space and the Upper-Atmosphere: Identifying the potential of new communications technologies for sustainable development* at 47, (Sep. 2017), available at http://www.broadbandcommission.org/Documents/publications/WG-Technologies-in-Space-Report2017.pdf.

Facebook has been active in the International Telecommunication Union's (ITU-R) study to facilitate access to broadband applications delivered by HAPS.[9] That study, under Agenda Item 1.14 for the World Radiocommunication Conference, is considering the possibility of adding an identification for HAPS at 21.4-22 GHz, 24.25-27.5 GHz, and 38-39.5 GHz. Agenda Item 1.14 is also considering whether the existing identification for HAPS in the 28 GHz and 31 GHz bands in about two dozen countries, largely in Asia, should be made global.[10] Facebook has assisted in preparing U.S. studies for the ITU-R, which show that HAPS, treated as an application in the terrestrial-fixed service, can co-exist with mobile, fixed and fixed satellite in these bands.[11] Facebook's analysis likewise shows that sharing is possible without requiring incumbents to modify their operations.[12]

Facebook supports identification in the ITU-R Radio Regulations of HAPS in the 21.4-22 GHz band, 24.25-27.5 GHz and 38-39.5 GHz band, as well as making the existing identification at 28/31 GHz available on a global basis, subject to technical conditions that are still being

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[9] Facebook's Aquila is designed to operate as a HAPS, as defined by the FCC in 47 C.F.R. §2.1 (c) ("A station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth. (RR)").

[10] *See* World Radiocommunication Conference, *Final Acts WRC-15*, Res. 160 at 261 n. 10 (2015), available at http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.297.43.en.100.pdf (recognizing an identification for HAPS in the 47.2-47.5 GHz, 47.9-48.2 GHz bands in addition to an identification in 27.9-28.2 GHz paired with the 31.0-31.3 GHz band in Region 2).

[11] *See* Chairman's Report, International Telecommunication Union Radiocommunication Sector Study Group 5, Working Party 5C, Document 5C/410, *Report on the Nineteenth Meeting of Working Party 5C,* 23-28, Annexes 16-20, *Sharing and Compatibility Studies of HAPS Systems in the 21.4-22 GHz, 24.25-27.5 GHz, 27.9-28.2 GHz and 31-31.3 GHz, 38-39.5 GHz, and 47.2-47.5 GHz and 47.9-48.2 GHz* (Nov. 27, 2017), available at https://www.itu.int/md/R15-WP5C-C-0410/en.

[12] *Id.*

discussed. In addition to terrestrial and satellite platforms, Facebook believes HAPS will provide a means to extend the reach of broadband networks in rural and remote areas. As bands like the 28 GHz and 37-40 GHz bands are built out for Upper Microwave Flexible Use Service ("UMFUS"), more users will enjoy high-speed connectivity and broadband providers will have more traffic to backhaul. 5G will generate more demand for higher broadband speeds and IoT applications in underserved markets. Within the 5G ecosystem, HAPS can help extend broadband networks with lower-cost backhaul without degrading 5G services. As noted by the United Nations Broadband Commission, "Developments in aeronautics and radio technologies have made HAPS a viable option to supplement existing network technologies and help bring broadband backhaul to unserved and underserved regions of the world, particularly remote and rural areas".[13]

Accordingly, Facebook recommends that the Commission consider rules that would allow stratospheric platform operations in the existing UMFUS bands of 28 GHz and 37-40 GHz,[14] consistent with sharing techniques ultimately adopted for HAPS in the 27.9-28.2 GHz band and the 38-39.5 GHz band, as well as consider licensing and payload equipment rules for the 24.25-27.5 GHz bands reviewed in the *Second Further Notice*, consistent with agreed mitigation techniques in the pending ITU-R. sharing studies. Relative to the Commission's request for comment on additional bands that should be considered for flexible use, Facebook

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[13] *See* Comments of Facebook at at 3, n.7., *Consultation on the Spectrum Outlook 2018 to 2022*, Innovation, Science and Economic Development Canada ("ISED"), Gazette Notice SLPB-006-17 (filed Jan. 9, 2018).

[14] *See Use of Spectrum Bands Above 24 GHz for Mobile Radio Services et al*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd. 8014, 8018 ¶ 3.

would recommend the 21.4-22 GHz range be allowed for HAPS operations, subject to appropriate technical rules.[15]

Facebook recommends that the Commission should add a Fixed Service allocation to the non-Federal table for the 24.45-25.05 GHz and 25.25-27.5 GHz bands, and allow stratospheric fixed links in those bands. Facebook would expand on this recommendation and suggest the Commission add a Fixed allocation at 24.45-25.05 GHz as well. Deployment of HAPS, whether in conjunction with or in lieu of ground-based terrestrial build-outs, could play a key role in allowing geographic licensees to quickly make use of their spectrum—as an initial deployment or a coordinated overlay—and should be an option for such licensees in the UMFUS bands. In response to the Commission's inquiry in the *Notice* whether it should grant additional flexibility to incumbent licensees to promote more efficient use of a given band, Facebook believes that where such flexibility does not already exist in the rules for terrestrial, granting licensees the ability to deploy spectrum using stratospheric solutions, through rule changes or waivers, would allow the licensees to make much more intensive use of their spectrum by taking advantage of spatial differentiation and self-coordination. Such flexibility would be facilitated by a Fixed allocation and HAPS identification being added to the relevant 24.25-27.5 GHz ranges.

Both in this proceeding, and with respect to the ITU-R study, Facebook supports identification of HAPS in the same bands for 5G or UMFUS, in order to promote economies of scale.[16] Without such economies, HAPS will be uneconomic for operators to serve rural areas.

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15 *See Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd. 6373, 6380 ¶¶ 21-23 (2017).

16 *See* Facebook FNPRM Comments at 4 ("Facebook fully supports the Commission's proposal to authorize flexible use licenses that would permit fixed and mobile services in a range of bands identified by the International Telecommunication Union for IMT-2020, specifically:

For these "towers in the sky" to be affordable platforms for terrestrial or satellite operators, economies of scale must exist for the microchips, phased-array antennas, and other components necessary for HAPS broadband payloads.

In conclusion, stratospheric platforms can be a pillar of tomorrow's wireless broadband solutions. As demonstrated by Facebook's *Aquila* project, as well as by recent announcements by Softbank and AeroVironment, Airbus, Thales, the Chinese and others, HAPS are not just a dream for the distant future but real technologies in development today. The Commission should seize this opportunity for the U.S. to lead the world in this innovative platform to support the 5G ecosystem.

Respectfully submitted by:

*/s/ Christopher Weasler*
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24.25-24.45 GHz and 24.75-25.5 GHz, 31.8 GHz-33.4 GHz, 42-42.5 GHz, 47.2 GHz-50.2 GHz, and 50.4 GHz-52.6 GHz.").